Binay
Lighting Up The Future

WHY LEDs FAIL

The Light Emitting Diode (LED) is the light source of the future, here today. While universally regarded as being generally indestructible in view of its long life and vibration-resistant construction, the LED is still essentially an electronic component (a diode which emits light as a by-product), and is liable to fail due to various reasons if certain design considerations are not taken into account.

The use of defective (rejected) LEDs, or defective selection of components with inadequate protection will result in loss of reliability. The major causes of LED failure are enumerated below:

Use of rejected LEDs available in the local market: LED manufacturers reject the LED when it has:

- *High V_f:* Improper bonding of the conductor wire at the anode of the LED chip causes an insufficient contact, leading to contact resistance and subsequent heat generation. Such defective LEDs have a higher voltage drop (beyond the specified limit). The LED chip will eventually **(not immediately)** fail due to overheating.

- *High I_r:* When the bonding operation causes excessive burning on the chip surface, I_r rises (again, beyond the specified limit), and the LED begins to conduct in both directions. High I_r LEDs will begin degrading in light output and **fail within six months of operation.**

  It is important to note that both the above defects will cause eventual – and NOT immediate – failure (after a period of time). This adds a further complexity to the issue of selecting proper LEDs, since the defect cannot be immediately pinpointed at the time of purchase or even at initial commissioning. The credibility of the vendor becomes of paramount importance in such a situation.

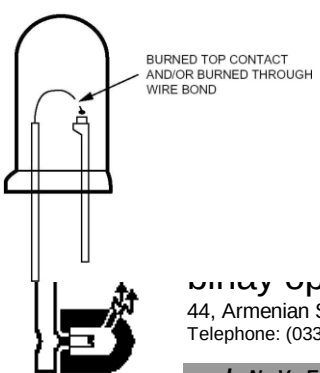
- *Lower light Intensity:* Due to bad chip centering, defective encapsulation epoxy, or bad encapsulation of epoxy.

Such defective LEDs are dumped by various manufacturers into the local markets, where they are available at extremely cheap rates (less than even the LED raw material cost).

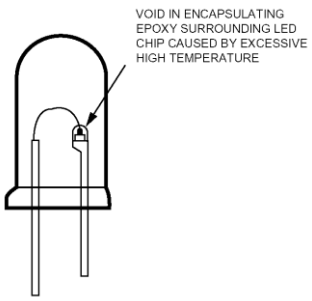
Binay ensures reliability by sourcing directly from reputed manufacturers, followed by careful checking of all LEDs for their electro-optical parameters.

Bad driver circuit design: Improper and technically unsound circuit design can cause premature failure of the LED.

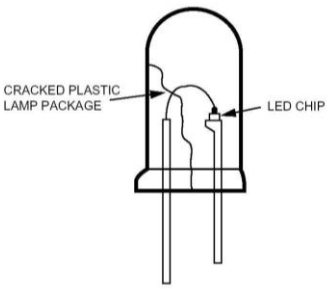
Passing excessive current through the LEDs (beyond the rated maximum forward current of the particular device), in an effort to get more light output will result in an open circuit catastrophic failure, breaking the anode-to-cathode electrical connection within the LED lamp or destroying the top contact on the LED chip.



Excessive heat (operating beyond 55°C ambient): All LED parameters derate with temperature. A proper design takes into account not only the rise in ambient temperature (by using appropriate LED driver circuits to prevent heat rise), but also adequate heatsinking of the heat generated by the LED chip. When the temperature of the LED chip exceeds the maximum, the epoxy material surrounding the chip is deformed, leading to optical distortion and a permanent Fresnel light loss of 50%.



Incorrect assembly procedures: Overheating of the LED lamp device by excessive soldering during assembly can cause breakage of the anode-to-cathode wire bond. More significantly, inappropriate bending of the LED leads during assembly causes stresses in the lead frame which are transmitted to the encapsulating epoxy, causing it to crack. Importantly, this cracking shows up not immediately, but later, as a latent field failure.



Long-term exposure to condensing moisture can cause the epoxy encapsulation of the LED to deteriorate. This will lead to catastrophic failure by corroding the top contact on the LED chip or by breaking the anode-to-cathode bonding wire, apart from decomposing the epoxy over time.

'Noisy/Dirty' line conditions, 'sparking' in line, EMI/RFI, line surges due to heavy machinery operation or the effect of lightning: This causes variation in the impedance values presented by the current control circuitry, resulting in heavy current surges and spikes. These can damage the LED chip and lead to light degradation by causing punctures at points on the chip junction.

Inadequate protection devices, such as improper selection of surge protectors.

Use of components of inappropriate rating (e.g., capacitors of 250VDC rating – instead of 400VDC rating – for 230VAC RMS circuits.

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